Text to accompany:

Open-File Report 79-809

1979

COAL RESOURCE OCCURRENCE MAPS OF THE MESA PORTALES QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

[Report includes 6 plates]

by

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This report has not been edited for conformity with U.S. Geological Survey editorial standards or stratigraphic nomenclature.

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MESA PORTALES 7 1/2-MINUTE QUADRANGLE

INTRODUCTION

Purpose

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps of the Mesa Portales quadrangle, Sandoval County, New Mexico. These maps were compiled to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the western United States. The work has been performed under contract with the Conservation Division of the U.S. Geological Survey (Contract No. 14-08-0001-17172).

The resource information gathered in this program is in response to the Federal Coal Leasing Amendments Act of 1976 and is a part of the U.S. Geological Survey's coal program. The information provides basic data on coal resources for land-use planning purposes by the Bureau of Land Management, state and local governments, and the public.

Location

The Mesa Portales 7 1/2-minute quadrangle is in northeastern Sandoval County, New Mexico. The area is approximately 64 miles (103 km) northwest of Santa Fe and 84 miles (135 km) southeast of Farmington, New Mexico.

Accessibility

The Mesa Portales quadrangle is accessible from New Mexico State Route 44, which is to the east, and State Route 197 which extends east-west across the area. Light-duty roads from the state routes provide further access to the area. The Atchison, Topeka, and Santa Fe Railway operates a route which passes through Albuquerque 70 miles (113 km) to the southeast.

Physiography

The northern part of the quadrangle is in the southeastern corner of the Central Basin area, and the southern part of the quadrangle is part of the northeastern Chaco Slope area (Kelley, 1950) of the structural depression known as the San Juan Basin. The quadrangle is within the Penistaja Cuestas physiographic sector as described by Baltz (1967). Elevations range from 6,700 ft (2,073 m) in the southeast to 7,750 ft (2,362 m) on Mesa de Cuba in the northeast. An area of low relief extends from the west-northwest to the center of the quadrangle and is dominated by the San Isidio Valley. Mesa Portales slopes gently to the north, but is terminated by a steep scarp along its southern and eastern margins. Mesa de Cuba is a prominent feature in the northeastern portion of the quadrangle. Numerous washes and arroyos, notably Arroyo Chijuilla, provide drainage for the area.

Climate

The climate of the San Juan Basin is arid to semi-arid. Annual precipitation is usually less than 10 inches (25 cm) but varies across the basin due to elevational differences. Rainfall is rare in the early summer; most precipitation occurs in July and August as intense afternoon thundershowers. Annual temperatures in the basin range from below 0°F (-18°C) to above 100°F (38°C). Snowfall may occur from November to April with an average of 18 inches (46 cm) in the southern part of the basin.

Land Status

Approximately 2 percent of the quadrangle is in the southeastern corner of the San Juan Basin Known Recoverable Coal Resource Area. The Federal Government owns the coal rights for all of the KRCRA land as shown on Plate 2 of the Coal Resource Occurrence Maps. No Federal coal leases occur in this area. The Federal Government owns the coal rights for 92 percent of the land outside the KRCRA.

GENERAL GEOLOGY

Previous Work

Dane (1936) mapped the Upper Cretaceous and Tertiary strata within the quadrangle with emphasis on outcrops of the Fruitland Formation coal and clinker. Fassett (1966) has mapped the geology of the quadrangle on a

scale of 1:24,000. Baltz (1967) published a Geological Survey Professional Paper on the stratigraphy and regional tectonic implications of the Upper Cretaceous and Tertiary rocks of the east-central San Juan Basin, which includes a geologic map of the northern two-thirds of the quadrangle. A more recent publication by Fassett and Hinds (1971) includes subsurface interpretations of the Fruitland Formation coal deposits throughout the San Juan Basin.

Geologic History

The San Juan Basin, an area of classic transgressive and regressive sedimentation, provided the ideal environment for formation of coals during Late Cretaceous time. At that time a shallow epeiric sea, which trended northwest-southeast, was northeast of the basin. The sea transgressed southwesterly into the basin area and regressed northeasterly numerous times; consequently, sediments from varying environments were deposited across the basin. Noncarbonaceous terrestrial deposition predominated during Paleocene and Eocene time.

The first basin-wide retreat of the Late Cretaceous sea is indicated by the nearshore deposits of the Point Lookout Sandstone. These ancient barrier beaches formed a generally northwest-southeast-trending strandline, behind which swamps developed. Organic material accumulated in the swamps and later became coal in the paludal deposits of the lower Menefee Formation. Deposition of materials which formed the coal beds was influenced by the strandline. This is shown by the more consistent

thickness and greater lateral extent of the coals parallel to the strandline and also by the lack of continuity perpendicular to it, to the northeast, where the Menefee and underlying Point Lookout deposits interfinger. Streams which crossed the swamps also influenced deposition of organic matter; stream deposits may terminate even the most continuous coal beds.

During the continued retreat of the sea, the depositional environments in the quadrangle area became more terrestrial. This is evidenced by the transition within the lower Menefee from carbonaceous to noncoal-bearing deposits, in which there is an upward decrease in the occurrence and lateral continuity of the coals. As the sea retreated, the sediments of the Point Lookout Sandstone and overlying Menefee Formation were deposited in successively higher stratigraphic positions to the northeast.

The sea then reversed the direction of movement, and the transgressive sequence of paludal upper Menefee Formation, nearshore Cliff House Sandstone, and marine Lewis Shale was deposited in the quadrangle. Swamps (Menefee) formed southwest (shoreward) of the transgressing beaches (Cliff House). Organic matter deposited in these swamps ultimately formed coal beds in the upper part of the Menefee Formation. A thin wedge of the Cliff House sand was deposited conformably over the Menefee Formation. Subsequently, several hundred feet of beach sands of the La Ventana Tongue (Cliff House Sandstone) were deposited over the basal Cliff House member.

Onlap continued as the sea moved southwestward across the basin area. The marine facies which developed northeast of the strandline as it moved to the southwest is the Lewis Shale. This thick sequence, which thins to the southwest, overlies the Cliff House Sandstone, and marks the last advance of the Late Cretaceous sea.

Evidence of the final retreat of the Late Cretaceous sea are the nearshore regressive Pictured Cliffs Sandstone and the overlying paludal Fruitland Formation which were deposited in successively higher stratigraphic positions to the northeast. Southwest (shoreward) of the beach deposits, which were dissected by streams, swamps accumulated organic matter which became coals of the Fruitland Formation. Again, deposition of organic material was influenced by the strandline as shown by both the continuity of the coal beds parallel to the northwest-southeast strandline and their discontinuity perpendicular to it to the northeast.

The brackish-water swamp environment of the Fruitland moved northeast of the quadrangle as the regression continued in that direction. Terrestrial sediments covered the area as indicated by the lacustrine, channel, and floodplain deposits of the Kirtland Shale. This sequence of events is evidenced by both an upward decrease in occurrence and thickness of Fruitland coals and a gradational change to noncarbonaceous deposits of the Kirtland. Continuous deposition during Late Cretaceous time ended with the Kirtland. The sea then retreated beyond the limits of the quadrangle area, and modern basin structure began to develop. An erosional unconformity developed in a relatively short time as part of the Cretaceous Kirtland Shale was removed.

Terrestrial deposition resumed in the Paleocene as represented by the Ojo Alamo Sandstone and the overlying Nacimiento Formation. Alluvial plain and floodplain deposits of the Ojo Alamo were followed by the thick, lithologically varied deposits of the Nacimiento during continuous nonmarine deposition (Powell, 1973). The Nacimiento was later exposed to erosion.

The Eocene San Jose Formation was subsequently deposited over the Nacimiento erosional surface, reflecting various nonmarine environments

which developed across the basin. Deposition and structural deformation of the basin then ceased, and the warped strata of the San Juan Basin have been exposed to the present time.

Stratigraphy

The formations studied in this quadrangle range from Late Cretaceous to Eocene in age. They are, in order from oldest to youngest: (the three formations of the Mesaverde Group) the Point Lookout Sandstone, Menefee Formation (undifferentiated), and Cliff House Sandstone; the Lewis Shale, Pictured Cliffs Sandstone, undivided Fruitland Formation and Kirtland Shale, Ojo Alamo Sandstone, Nacimiento Formation, and San Jose Formation. A composite columnar section on CRO Plate 3 illustrates the stratigraphic relationships of these formations and is accompanied by lithologic descriptions of the individual formations.

The Point Lookout Sandstone, the basal formation of the Mesaverde Group, consists of gray to brown fine- to medium-grained calcareous sandstone and interbedded shale. It is fairly massive in character, averages 190 ft (58 m) in thickness, and displays a distinctive character on geophysical logs. This last characteristic was used by the authors in establishing the top of the Point Lookout as a lithologic datum for correlation of the overlying Menefee coals.

The oldest coal-bearing formation in the quadrangle is the Menefee Formation of the Mesaverde Group. In previous studies the Menefee has been divided into the Cleary Coal Member, the barren Allison Member, and an unnamed upper coal-bearing member (Beaumont and others, 1956). These three

members are referred to as the undifferentiated Menefee Formation for the purposes of this report only. The Menefee in this area is about 665 ft (203 m) thick and is predominantly a gray to brown carbonaceous to noncarbonaceous shale with interbedded siltstone and sandstone, and random coal beds.

The Cliff House Sandstone sequence conformably overlies the Menefee Formation. A thin basal sand member, referred to as "the Cliff House Sandstone" by Fassett (1977), correlates with the thin undifferentiated Cliff House Sandstone to the northeast. It is about 40 ft (12 m) thick and consists of white to buff calcareous sandstone.

Overlying the basal member in the southern half of the area is the La Ventana Tongue. This member of the Cliff House Sandstone is about 690 ft (210 m) thick and represents a thick sandstone sequence composed primarily of white to buff sandstone and thinly-interbedded gray shale and siltstone.

The marine Lewis Shale conformably overlies the basal Cliff House in the northern part of the quadrangle and the La Ventana in the southern part. In contrast to the underlying Cliff House Sandstone, the Lewis Shale is predominantly a gray, locally silty, fossiliferous, calcareous shale with interbedded thin, gray, calcareous siltstone. It averages 720 ft (219 m) in thickness throughout the quadrangle. The upper contact of the Lewis Shale is gradational with the overlying Pictured Cliffs Sandstone and, therefore, it is difficult to determine.

The Pictured Cliffs Sandstone consists of approximately 110 ft (34 m) of gray to brown, fine-grained calcareous sandstone interbedded with thin shale near the base of the formation where it grades into the Lewis. The upper contact of the Pictured Cliffs Sandstone is more sharply defined

than the basal contact, even though intertonguing with the overlying Fruitland Formation results in minor variations in the formational top. Since the Pictured Cliffs is present throughout most of the basin and displays a distinctive character on geophysical logs, the authors have used the top as a lithologic datum for correlation of the overlying Fruitland coals.

Conformably overlying the Pictured Cliffs Sandstone is the undivided Fruitland Formation and Kirtland Shale, the lower portion of which is the major coal-bearing unit in the quadrangle. The average combined thickness of the units is 220 ft (67 m). It consists of gray to green to greenish-brown carbonaceous to noncarbonaceous shale, interbedded white to brown sandstone and siltstone, and coal beds of varying thicknesses. The thickest and most continuous coal beds of the Fruitland occur near the base of the formation, while discontinuous and lenticular coal beds are characteristic of the upper portion.

The Paleocene Ojo Alamo Sandstone unconformably overlies the Upper Cretaceous deposits. It consists of about 50 ft (15 m) of light to dark brown, fine- to coarse-grained sandstone with interbedded thin, gray to green shale.

Approximately 1,200 ft (366 m) of the Nacimiento conformably overlie the Ojo Alamo in the area. These rocks are predominantly light gray to black shale with interbedded sandstone.

The Eocene San Jose Formation unconformably overlies the Paleocene Nacimiento Formation. The San Jose consists of buff to yellow, fine- to coarse-grained, locally conglomeratic, arkosic sandstone with interbedded brown to gray shale.

A total of eight formations crop out within the quadrangle. The outcrop pattern trends in a east-west direction, the formations becoming successively younger to the north. The oldest formation is the La Ventana Tongue (Cliff House Sandstone) which crops out in the southeastern corner of the area. The entire sections of the Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, Ojo Alamo Sandstone, and Nacimiento Formation crop out consecutively across the quadrangle. The basal part of the San Jose Formation, the youngest formation, crops out along the northern boundary of the quadrangle as a caprock on various mesas.

Structure

The axis of the San Juan basin is about 22 miles (35 km) northeast of the Mesa Portales quadrangle area and trends in an arcuate pattern across the northern portion of the Central Basin (Baltz, 1967). Regional dip measured within the quadrangle ranges from 2° to 3° to the north, northeast and west (Dane, 1936). Several small-scale faults are in the south-central portion of the quadrangle; the amount of displacement was not determined.

COAL GEOLOGY

Individual coal beds are not continuous across the San Juan Basin because the coal related strata are progressively younger from southwest to northeast; the strata rise in steps due to minor transgressions which occurred during the overall retreat of the sea. However, for the exclusive purpose of reserve and reserve base calculations, the Fruitland 1 coal bed

has been correlated and mapped as if it was a single bed, continuous throughout the basin.

A lithologic datum was used for correlation of the coals (CRO Plate 3). The primarily marine sandstone units (Point Lookout, Pictured Cliffs) which underlie the coal-bearing formations (Menefee, Fruitland) were used as datums since they represent a more laterally continuous boundary than any of the overlying paludal, fluvial, and lacustrine deposits of the coal-bearing formations. Also, the sandstone units are generally more easily recognized on geophysical logs. As shown on CRO Plate 3, the tops of the sandstone units have been used as datums for each drill hole, and the coals have been plotted in the column and correlated based upon their position relative to the datum. Correlations of Fruitland coals in measured sections are based upon the geologic maps of this quadrangle (Fassett, 1966).

One coal zone (Menefee) was identified in the subsurface, and a coal bed (Fruitland 1) was mapped on the surface of this quadrangle (CRO Plate 1). The Menefee Formation coal beds are designated as the Menefee coal zone (Me zone). These coal beds are generally noncorrelative and less than reserve base thickness (5 ft [1.5 m]) as specified by the U.S. Geological Survey; however, there is a 5-ft (1.5-m) coal bed in drill holes 7 and 10 (CRO Plate 1).

Menefee Formation coal beds in the southeastern part of the San Juan Basin vary from subbituminous B to high volatile C bituminous in rank. The rank of the coal has been determined on a moist, mineral-matter-free basis with calorific values ranging from 9,983 to 11,966 Btu's per pound (23,220-27,833 kj/kg) (Amer. Soc. for Testing and Materials, 1977). The coal is hard, brittle, and black with a bright luster. The coal readily slakes

with exposure to weather; however, it stocks fairly well when protected. The "as received" analyses indicate a moisture content varying from 12.1 to 20.0 percent, ash content ranging from 4.9 to 9.9 percent, sulfur content generally less than one percent, and heating values on the order of 10,343 Btu's per pound (24,058 kj/kg). There is no apparent consistent difference between the various Menefee Formation coal beds (Dane, 1936; Shomaker, 1971). Analyses of several Menefee Formation coal beds are published in a report by Shomaker (1971). The results of these analyses are given in Table 1.

The Fruitland 1 (Fr 1) coal bed is defined by the authors as the lowermost coal of the Fruitland Formation; it is generally directly above the Pictured Cliffs Sandstone. The Fruitland 1 coal bed crops out in the southeastern part of the quadrangle and is offset by two minor faults (Fassett, 1966). Since the Fruitland 1 coal bed is less than reserve base thickness (5 ft [1.5 m]) in this quadrangle, derivative maps were not constructed.

Fruitland Formation coal beds in the southeastern part of the San Juan Basin vary from subbituminous A to high volatile A bituminous in rank. The rank of the coal has been determined on a moist, mineral-matter-free basis with calorific values ranging from 11,358 to 14,545 Btu's per pound (26,419-33,832 kj/kg) (Amer Soc. for Testing and Materials, 1977). The coal is hard, brittle, and black with a bright luster. The coal readily slakes with exposure to weather; however, it stocks fairly well when protected. The "as received" analyses indicate a moisture content varying from 2.1 to 13.48 percent, ash content ranging from 19.86 to 30.49 percent, sulfur content less than one percent, and heating values on the order of 8,888 Btu's per pound (20,673 kj/kg). Analyses of several Fruitland Formation coal beds are given in Table 2 (Dane, 1936; Fassett and Hinds, 1971; Shomaker and Lease, 1971).

TABLE 1

Analyses of coal samples from the Menefee Formation

(Form of analysis: A, as received; B, moisture free; C, moisture and ash free)

U.S. Bureau Mines Lab No.	Well or Other Source	Location			Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent					Heating Value (Btu)	Remarks
		Section	T.N.	R.W.			Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur		
A-47085	Mine Sample San Juan Mine	SW¼ 31	19	1	----	A	15.8	34.5	43.8	5.9	0.6	10,900	Cleary Member
						B	----	41.0	52.0	7.0	0.7	12,930	
A-46366	Mine Sample San Juan Mine	SW¼ 31	19	1	----	A	15.7	32.0	45.1	7.2	0.6	10,790	Cleary Member,
						B	----	38.0	53.5	8.5	0.7	12,800	
						C	----	41.5	58.5	----	0.8	13,990	
A-47084	Prospect Pit Wilkins No.2 Prospect	SW¼ 26	19	1	----	A	18.2	34.4	40.8	6.6	0.9	10,280	Cleary Member
						B	----	42.0	49.9	8.1	1.0	12,570	
A-46026	Mine Sample Rio Puerco Mine	SE¼ 19	19	1	----	A	13.1	35.8	44.5	7.6	2.8	10,940	Allison Member
						B	----	40.7	50.6	8.7	3.2	12,460	
						C	----	44.6	55.4	----	3.5	13,640	
A-44268	Mine Sample Anderson Mine	SE¼ 35	19	2	----	A	20.0	32.5	42.6	4.9	0.7	10,240	Allison Member
						B	----	40.7	53.3	6.1	0.8	12,790	
						C	----	43.3	56.7	----	0.9	13,630	
A-46367	Prospect Drift	35	19	2	----	A	14.8	33.9	41.4	9.9	1.2	8,910	Allison Member;
						B	----	39.8	48.6	11.6	1.4	10,460	Sample may have
						C	----	45.1	54.9	----	1.6	11,840	been somewhat weathered

To convert Btu's/lb to kj/kg, multiply Btu's/lb by 2.326.
To convert feet to meters, multiply feet by 0.3048.

TABLE 2

Analyses of coal samples from the Fruitland Formation

(Form of analysis: A, as received; B, moisture free; C, moisture and ash free)

U.S. Bureau Mines Lab No.	Well or Other Source	Location Section	T.N.	R.W.	Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur	Heating Value (Btu)	Remarks
+TN-55298	Core Sample	------	19	3	----	A	9.44	27.40	32.67	30.49	0.37	8,161	
						B	-----	30.26	36.07	33.67	0.63	9,012	
+TN-55672	Core Sample	------	19	4	----	A	11.50	36.57	32.07	19.86	0.67	9,473	
						B	-----	41.32	36.24	22.44	0.76	10,704	
+TN-57167	Core Sample	------	19	3	----	A	13.13	32.63	32.46	21.73	0.49	9,003	
						B	-----	37.56	37.37	25.07	0.56	10,364	
+TN-57168	Core Sample	------	19	3	----	A	12.03	30.39	27.96	29.60	0.39	7,870	
						B	-----	34.55	31.79	33.66	0.67	8,948	
+TN-57166	Cuttings Sample	------	19	3	----	A	13.48	29.55	28.05	28.92	0.50	7,829	
						B	-----	34.15	32.42	33.43	0.58	9,049	
H-32405	El Paso Nat. Gas Lindrith No. 42	NE¼ 22	24	3	3,194-3,205	A	2.1	38.7	36.7	22.5	0.7	10,990	
						B	-----	39.5	37.5	23.0	0.7	11,230	
						C	-----	51.3	48.7	----	1.0	14,580	

+analysis by Commercial Testing and Eng. Co.

To convert Btu's/lb to kj/kg, multiply Btu's/lb by 2.326.
To convert feet to meters, multiply feet by 0.3048.

Menefee Coal Zone

The Menefee coal zone extends from the top of the La Ventana Tongue (Cliff House) to the base of the Menefee Formation. Correlation of the top of the La Ventana, which is easily recognized on geophysical logs, with the top of the Menefee Formation was established for use in the surrounding quadrangles, where they interfinger and are contemporaneous, and has been continued into the quadrangle for the purpose of consistency.

Consequently, the structure contour map of the Menefee coal zone (CRO Plate 5) was constructed using the top of the La Ventana Tongue of the Cliff House Sandstone. The structure contour map shows that the Menefee coal zone dips from approximately 3.5° to less than 1° in a northerly direction. As a result of topography and dip, overburden (CRO Plate 6) varies from less than 400 ft (122 m) in the southwest to over 2,400 ft (732 m) on Mesa de Cuba. Included on CRO Plate 6 is the total amount of interburden, the noncoal portion of the coal zone. The interburden thickness varies from less than 1,300 ft (396 m) in the north to greater than 1,550 ft (472 m) in the southern part of the quadrangle. The large values are the result of the stratigraphic spread of the coal beds and reflect the thickness of the Menefee Formation plus the La Ventana Tongue. The isopach map (CRO Plate 4) shows the total combined thickness of the individual coal beds of the Menefee zone. The greatest combined thickness occurs in the northwestern portion of the quadrangle where the coals total more than 30 ft (9.1 m). In general, the thickness decreases from this area, and there is no coal present in a small portion of the central part of the quadrangle.

Chemical Analyses of the Menefee Zone Coal Beds - No published analyses of the quality of Menefee Formation coals are available for this quadrangle. However, information from surrounding areas is assumed to be similar to that of the coals from this quadrangle. Analyses of several Menefee Formation coals are presented in a report by Shomaker (1971). The results of these analyses are given in Table 1.

COAL RESOURCES

Coal resource data from oil and gas wells (El Paso Natural Gas Co., 1978, unpublished data in well log library in Farmington, New Mexico) and geologic maps (Fassett, 1966) were used in the construction of the isopach and structure contour map for this quadrangle. Coal resources were not calculated for the Fruitland 1 coal bed or the Menefee zone coal beds. The Fruitland 1 coal bed is discontinuous and less than the reserve base thickness of 5 ft (1.5 m). Coal beds of the Menefee zone are noncorrelative and generally less than 5 ft (1.5 m) thick.

COAL DEVELOPMENT POTENTIAL

Coal development potential maps were not constructed for this quadrangle because the coal beds within the KRCRA are less than the reserve base thickness (5 ft [1.5 m]) and, therefore, have unknown coal development potential.

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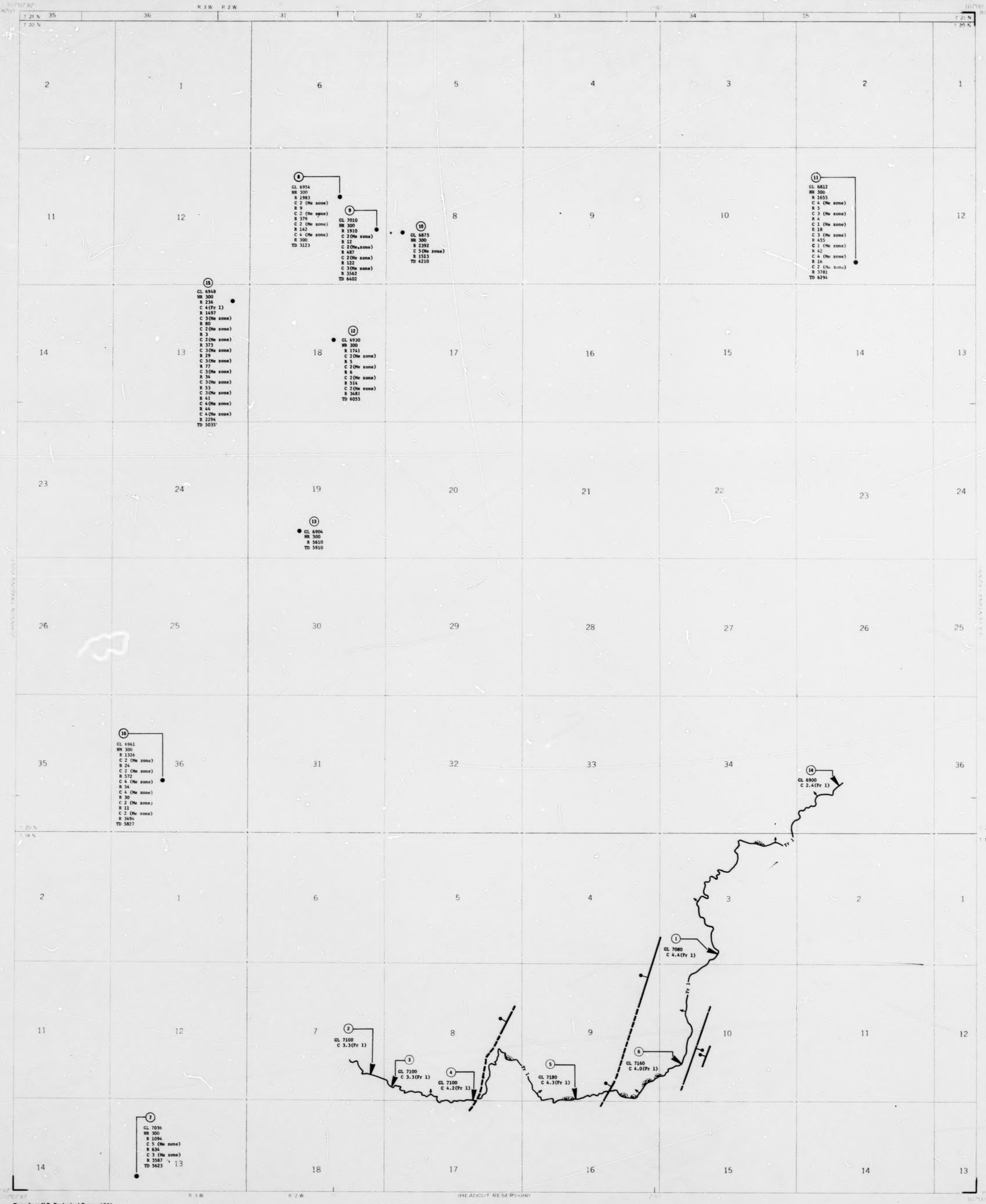
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MESA PORTALES QUADRANGLE
NEW MEXICO-SANDOVAL CO
7.5 MINUTE SERIES (TOPOGRAPHIC)

OPEN FILE REPORT 79-809
PLATE I OF 6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(7) GL 7036 NR 300 R 1094 C 5 (Me zone) R 634 C 3 (Ne zone) R 3587 TD 5623
(8) GL 6954 NR 300 R 1983 C 2 (Me zone) R 9 C 2 (Me zone) R 379 C 2 (Me zone) R 142 C 4 (Me zone) R 300 TD 3123
(9) GL 7010 NR 300 R 1910 C 2(Me zone) R 12 C 2(Me zone) R 487 C 2(Me zone) R 122 C 3(Me zone) R 3562 TD 6402
(10) GL 6875 NR 300 R 2392 C 5(Me zone) R 1513 TD 4210
(11) GL 6812 NR 300 R 1655 C 4 (Me zone) R 5 C 3 (Me zone) R 4 C 1 (Me zone) R 18 C 3 (Me zone) R 455 C 1 (Ne zone) R 42 C 4 (Me zone) R 16 C 2 (Ne zone) R 3781 TD 6294
(12) GL 6930 NR 300 R 1741 C 2(Me zone) R 5 C 2(Me zone) R 6 C 2(Me zone) R 514 C 2(Me zone) R 3481 TD 6055
(13) GL 6904 NR 300 R 5610 TD 5910
(14) GL 6900 C 2.4(Fr 1)
(15) GL 6948 NR 300 R 238 C 4(Fr 1) R 1497 C 3(Ne zone) R 80 C 2(Ne zone) R 3 C 2(Ne zone) R 373 C 3(Ne zone) R 29 C 3(Ne zone) R 77 C 3(Ne zone) R 34 C 3(Ne zone) R 53 C 3(Ne zone) R 41 C 4(Ne zone) R 44 C 4(Ne zone) R 2294 TD 5035'
(16) GL 6961 NR 300 R 1326 C 2 (Ne zone) R 24 C 2 (Ne zone) R 572 C 4 (Ne zone) R 54 C 4 (Ne zone) R 30 C 2 (Ne zone) R 11 C 2 (Ne zone) R 3494 TD 5827
Fr 1
THE ADOBE RESERVOIR

EXPLANATION

(10) ● GL 6875
NR 300
R 2392
C 5(Ne zone)
R 1513
TD 4210

DRILL HOLE - Shown solid for oil and gas. Showing drill hole data, in feet. Index number refers to well on Plate 3 of CRO map.

GL - Ground level elevation
NR - No record
R - Rock interval
C - Coal interval
TD - Total depth

TEST HOLE AND MEASURED SECTION DATA SYMBOLS

Fr 1 - Fruitland 1 bed
Ne zone - Menefee zone

COAL BED AND COAL ZONE SYMBOLS AND NAMES

(4) GL 7100
C 4.2 (Fr1)
Fr 1

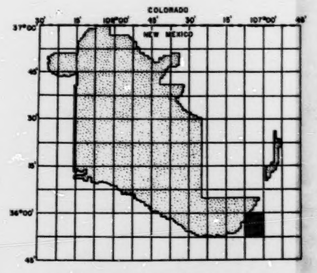
TRACE OF COAL BED OUTCROP - Showing coal thickness, in feet, measured at triangle. Index number refers to measured section on Plate 3 of CRO map. Arrow points toward the coal-bearing area. Trace of coal bed outcrop modified (from original data source) to fit modern topographic map.

BURNED AND CLINKERED COAL BED - Showing area of baked and fused rock (w symbol). Dotted line indicates inferred limit of burning.

FAULT - Dashed where approximately located; bar and ball on downthrown side.

To convert feet to meters, multiply feet by 0.3048.

NR is an average of 300 ft (91 m) of casing. Actual depth of casing not shown.



MAP SHOWING LOCATION OF THE MESA PORTALES QUADRANGLE (SHADED) AND THE SAN JUAN BASIN KNOWN RECOVERABLE COAL RESOURCE AREA (STIPPLED), NEW MEXICO

Base from U.S. Geological Survey, 1961

SCALE 1:24 000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

Compiled in 1979

COAL RESOURCE OCCURRENCE MAP OF THE MESA PORTALES QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

BY

DAMES & MOORE

1979

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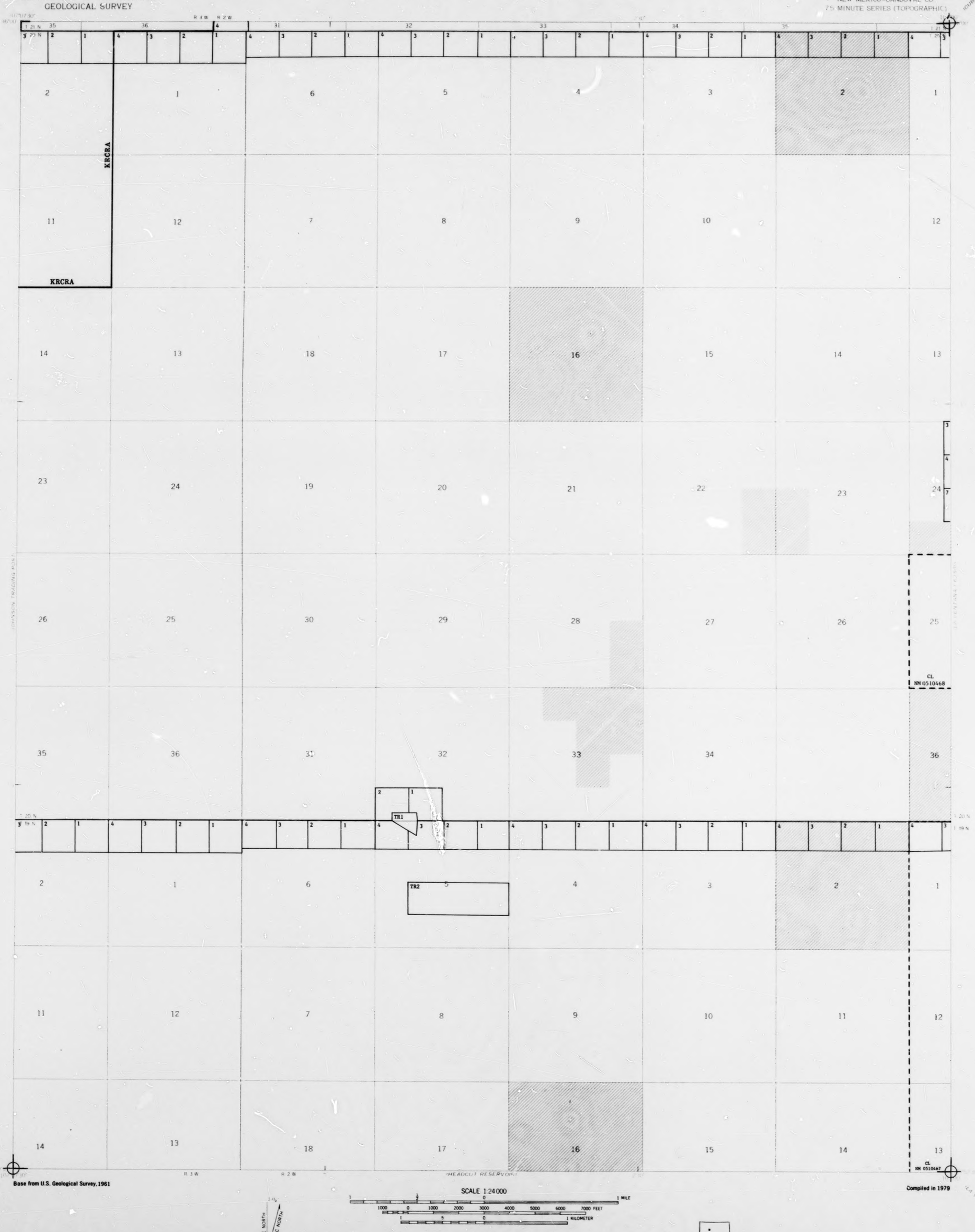
PLATE 1
COAL DATA MAP

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MESA PORTALES QUADRANGLE
NEW MEXICO-SANDOVAL CO
7.5 MINUTE SERIES (TOPOGRAPHIC)

OPEN FILE REPORT 79-809
PLATE 2 OF 6



Base from U.S. Geological Survey, 1961

Compiled in 1979

SCALE 1:24 000

1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

TRUE NORTH
MAGNETIC NORTH
DECLINATION, 1961

NEW MEXICO
QUADRANGLE LOCATION

EXPLANATION

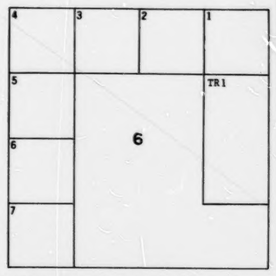
KRCRA

KRCRA BOUNDARY - Label within KRCRA boundary.

NON-FEDERAL COAL LAND - Land within the KRCRA boundary for which the Federal Government does not own the coal rights.

CL
NM 0510468

COAL LEASE - Showing lease number.



SECTION OF LAND - Showing lots and lot numbers; and tracts and tract numbers.

NOTE: BLM Coal Ownership Data current as of October 18, 1977.

REFERENCE

U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geological Survey Bulletin 1450-B, 7 p.

COAL RESOURCE OCCURRENCE MAP OF THE MESA PORTALES QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

BY

DAMES & MOORE

1979

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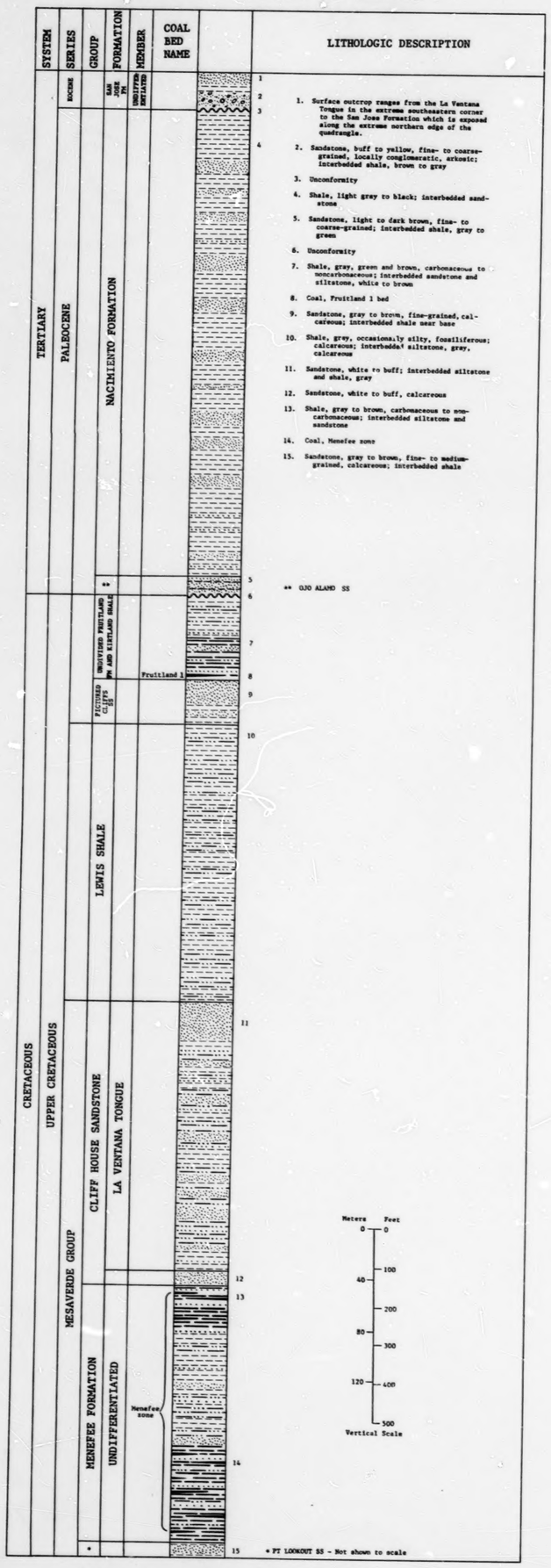
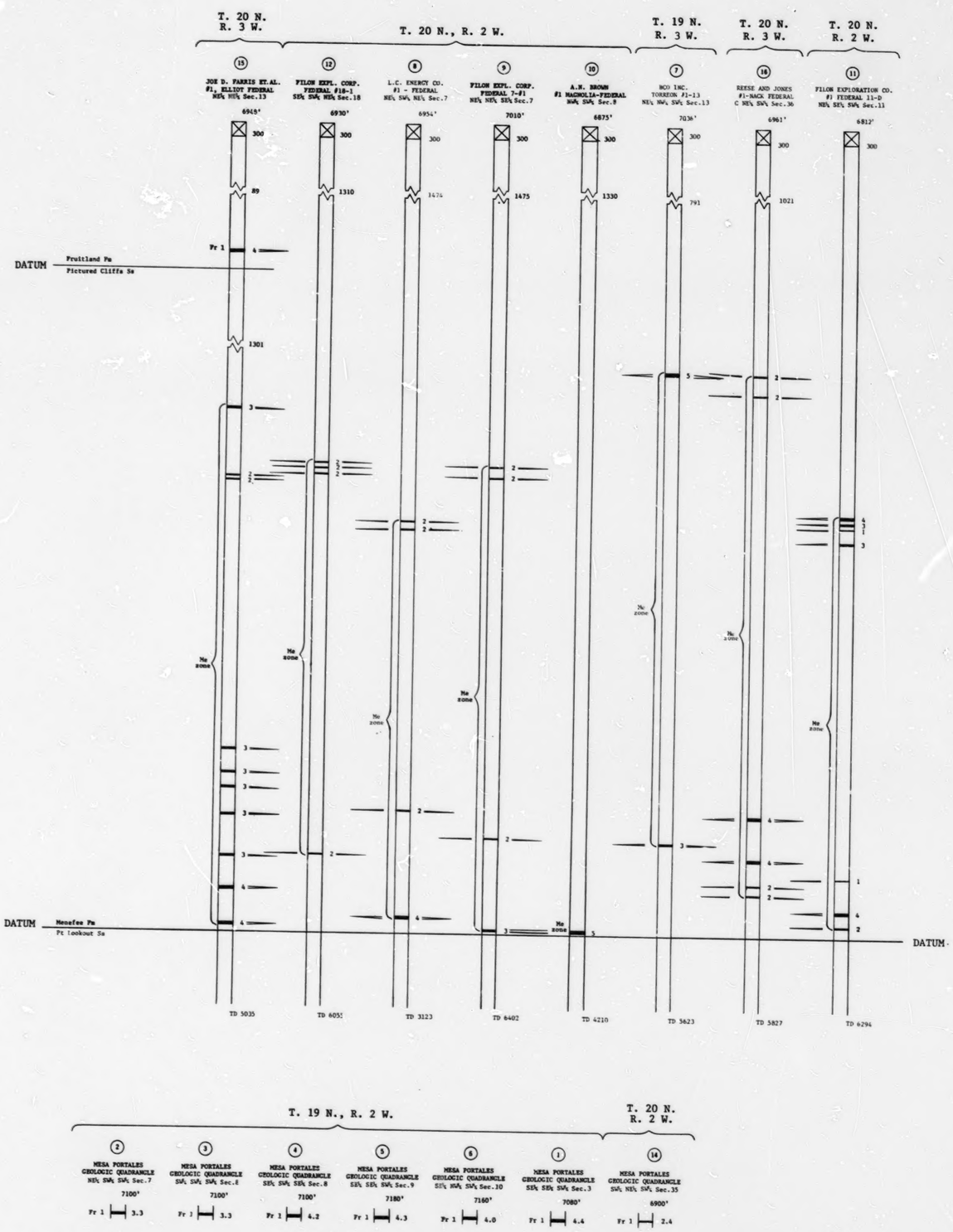
PLATE 2

BOUNDARY AND COAL DATA MAP

COMPOSITE COLUMNAR SECTION

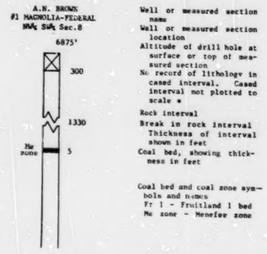

SYSTEM
SERIES
GROUP
FORMATION
MEMBER
COAL BED NAME
LITHOLOGIC DESCRIPTION
TERTIARY
PALEOCENE
NACIMIENTO FORMATION
CRETACEOUS
UPPER CRETACEOUS
MESAVERDE GROUP
CLIFF HOUSE SANDSTONE
LA VENTANA TONGUE
LEWIS SHALE
PICTURED CLIFFS SS
(RIO)TITUDO FRUITLAND FM. AND KIRTLAND SHALE
UNDIFFERENTIATED
MENEFEE FORMATION
Fruitland 1
Menefee zone
1. Surface outcrop ranges from the La Ventana Tongue in the extreme southeastern corner to the San Jose Formation which is exposed along the extreme northern edge of the quadrangle.
2. Sandstone, buff to yellow, fine- to coarse-grained, locally conglomeratic, arkosic; interbedded shale, brown to gray
3. Unconformity
4. Shale, light gray to black; interbedded sandstone
5. Sandstone, light to dark brown, fine- to coarse-grained; interbedded shale, gray to green
6. Unconformity
7. Shale, gray, green and brown, carbonaceous to noncarbonaceous; interbedded sandstone and siltstone, white to brown
8. Coal, Fruitland 1 bed
9. Sandstone, gray to brown, fine-grained, calcareous; interbedded shale near base
10. Shale, gray, occasionally silty, fossiliferous; calcareous; interbedded siltstone, gray, calcareous
11. Sandstone, white to buff; interbedded siltstone and shale, gray
12. Sandstone, white to buff, calcareous
13. Shale, gray to brown, carbonaceous to noncarbonaceous; interbedded siltstone and sandstone
14. Coal, Menefee zone
15. Sandstone, gray to brown, fine- to medium-grained, calcareous; interbedded shale
** OJO ALAMO SS
* PT LOOKOUT SS - Not shown to scale
Meters
Feet
Vertical Scale

CORRELATION OF COAL BEDS IN DRILL HOLES AND MEASURED SECTIONS


T. 20 N. R. 3 W.
T. 20 N., R. 2 W.
T. 19 N. R. 3 W.
T. 20 N. R. 3 W.
T. 20 N. R. 2 W.
15 JOE D. FARRIS ET.AL. #1, ELLIOT FEDERAL NE¼ NE¼ Sec.13 6948'
12 PILON EXPL. CORP. FEDERAL #18-1 SE¼ SW¼ NE¼ Sec.18 6930'
8 L.C. ENERGY CO. #1 - FEDERAL NE¼ SW¼ NE¼ Sec.7 6954'
9 PILON EXPL. CORP. FEDERAL 7-#1 NE¼ NE¼ SE¼ Sec.7 7010'
10 A.N. BROWN #1 MAGNOLIA-FEDERAL NW¼ SW¼ Sec.8 6875'
7 HCO INC. TORREON #1-13 NE¼ NW¼ SW¼ Sec.13 7036'
16 REESE AND JONES #1-MACK FEDERAL C NE¼ SW¼ Sec.36 6961'
11 PILON EXPLORATION CO. #1 FEDERAL 11-D NE¼ SE¼ SW¼ Sec.11 6812'
DATUM
Fruitland Fm
Pictured Cliffs Ss
Menefee Fm
Pt lookout Ss
Fr 1
Me zone
TD 5035
TD 6055
TD 3123
TD 6402
TD 4210
TD 3623
TD 5827
TD 6294

T. 19 N., R. 2 W.
T. 20 N. R. 2 W.
2 MESA PORTALES GEOLOGIC QUADRANGLE NE¼ SW¼ SW¼ Sec.7 7100' Fr 1 3.3
3 MESA PORTALES GEOLOGIC QUADRANGLE SW¼ SW¼ SW¼ Sec.8 7100' Fr 1 3.3
4 MESA PORTALES GEOLOGIC QUADRANGLE SE¼ SW¼ SE¼ Sec.8 7100' Fr 1 4.2
5 MESA PORTALES GEOLOGIC QUADRANGLE SE¼ SE¼ SW¼ Sec.9 7180' Fr 1 4.3
6 MESA PORTALES GEOLOGIC QUADRANGLE SE¼ NW¼ SW¼ Sec.10 7160' Fr 1 4.0
1 MESA PORTALES GEOLOGIC QUADRANGLE SE¼ SE¼ SW¼ Sec.3 7080' Fr 1 4.4
14 MESA PORTALES GEOLOGIC QUADRANGLE SW¼ NE¼ SW¼ Sec.35 6900' Fr 1 2.4

EXPLANATION



Index number
Well or measured section name
Well or measured section location
Altitude of drill hole at surface or top of measured section
No record of lithology in cased interval. Cased interval not plotted to scale *
Rock interval
Break in rock interval Thickness of interval shown in feet
Coal bed, showing thickness in feet

Coal bed and coal zone symbols and names
Fr 1 - Fruitland 1 bed
Me zone - Menefee zone

Total depth of well, in feet

*An average depth of casing of 300 ft (91 m) was used. Actual depth of casing not shown.

Meters Feet
Vertical Scale

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

OPEN FILE REPORT 79-809
PLATE 3 OF 6

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COAL RESOURCE OCCURRENCE MAP OF THE MESA PORTALES QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

BY
DAMES & MOORE

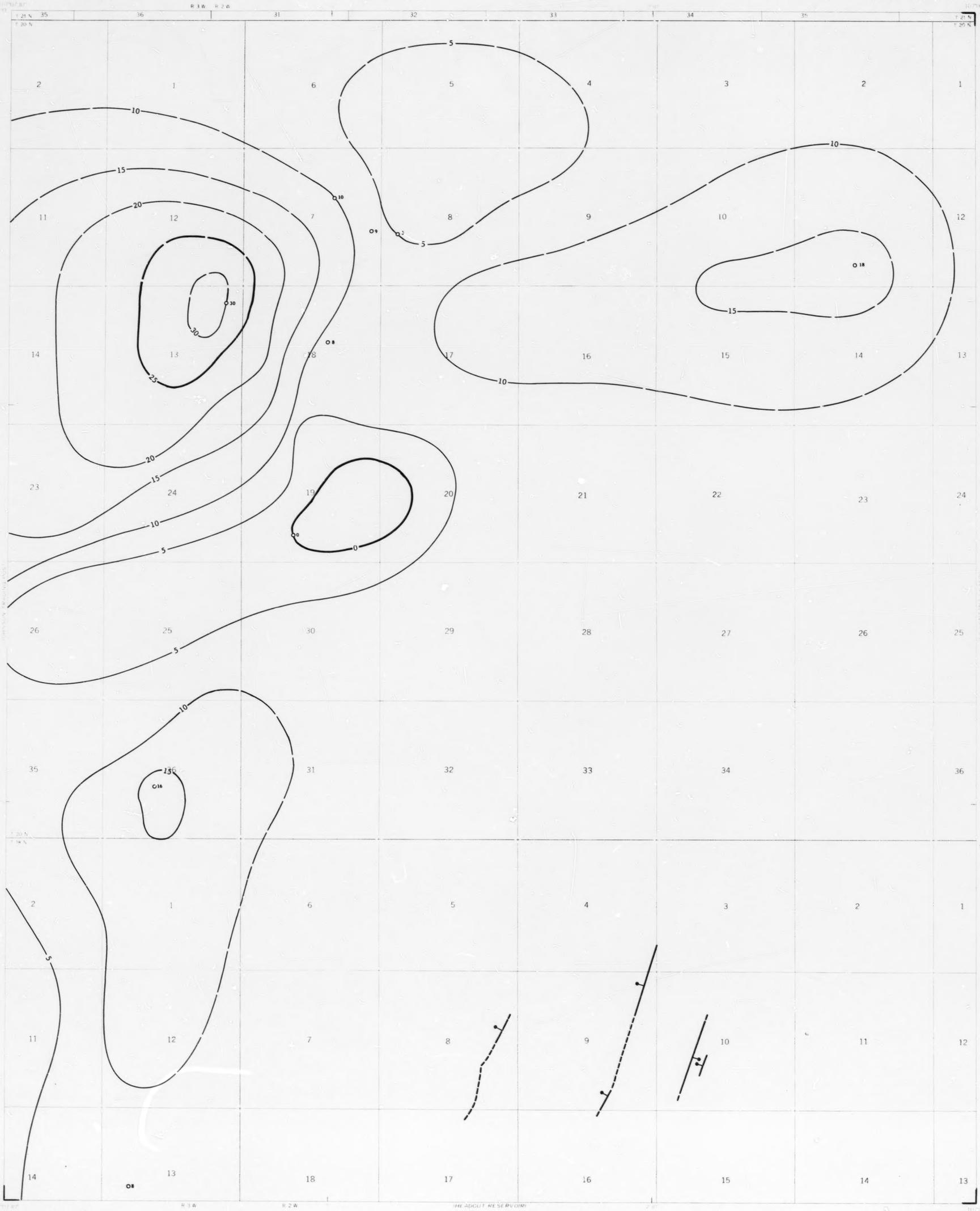
1979

Compiled in 1979

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MESA PORTALES QUADRANGLE
NEW MEXICO-SANDOVAL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

OPEN FILE REPORT 79-809
PLATE 4 OF 6



EXPLANATION

0
5

ISOPACHS OF THE MENEFEE ZONE COAL BEDS- Showing total coal thickness, in feet. Isopach interval 5 feet (1.5 meters). Isopachs dashed where inferred.

18

DRILL HOLE - Showing total thickness of Menefee zone coal beds, in feet.

FAULT - Dashed where approximately located; bar and ball on downthrown side.

To convert feet to meters, multiply feet by 0.3048.

Base from U.S. Geological Survey, 1961

SCALE 1:24000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 5 0 1 KILOMETER

Compiled in 1979

TRUE NORTH
MAGNETIC NORTH
DECLINATION, 1961

NEW MEXICO
QUADRANGLE LOCATION

COAL RESOURCE OCCURRENCE MAP OF THE MESA PORTALES QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

BY

DAMES & MOORE

1979

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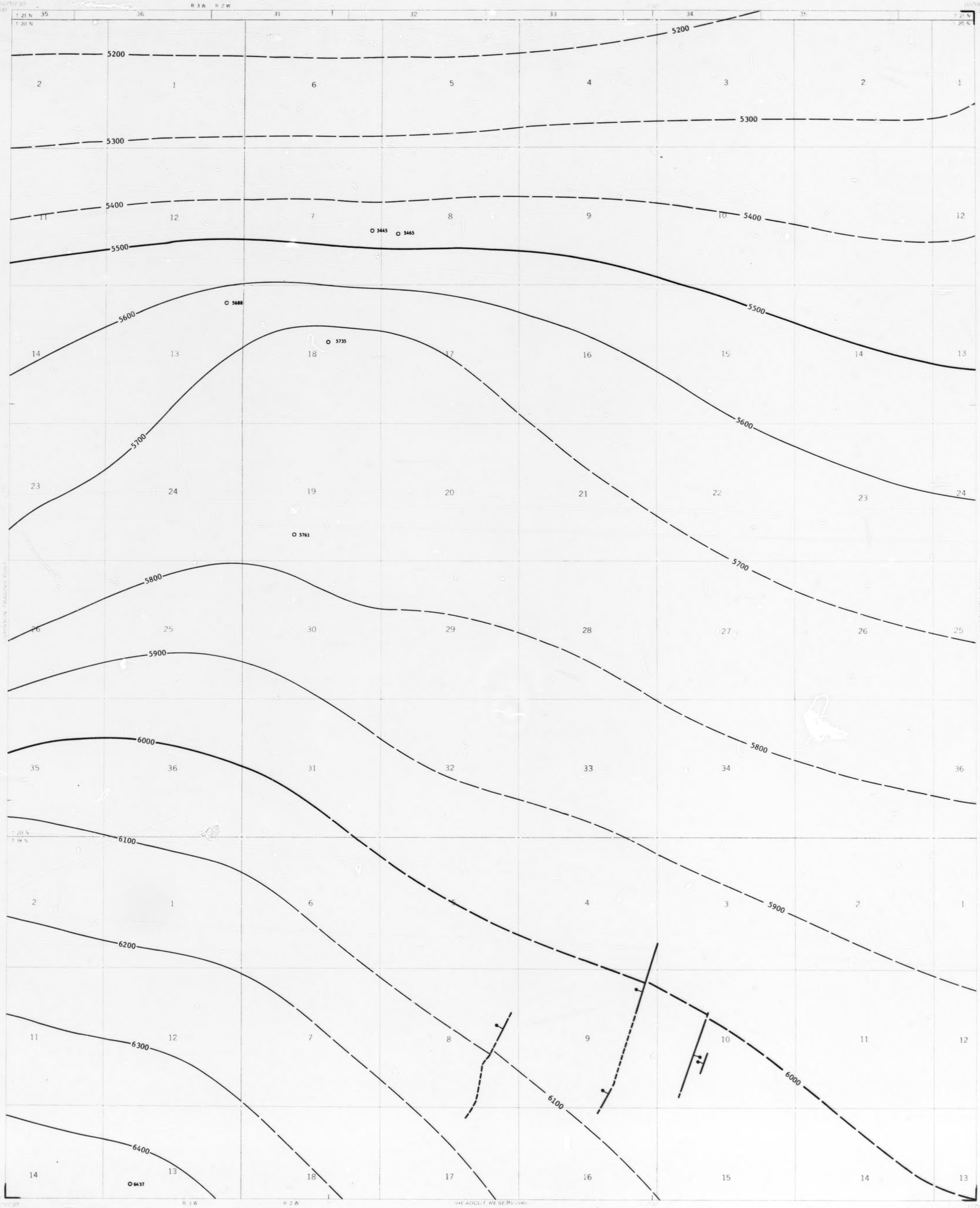
PLATE 4

ISOPACH MAP OF THE TOTAL COAL OF THE MENEFEE COAL ZONE

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MESA PORTALES QUADRANGLE
NEW MEXICO-SANDOVAL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

OPEN FILE REPORT 79-809
PLATE 5 OF 6



EXPLANATION

6000
6100

STRUCTURE CONTOURS - Drawn on top of the Menefee coal zone, which is coincident with the top of the La Ventana Tongue. Contour interval 100 ft (30.5 meters). Datum is mean sea level. Contours dashed where inferred.

○ 5761

DRILL HOLE - Showing altitude at the top of the Menefee coal zone, in feet.

FAULT - Dashed where approximately located; bar and ball on downthrown side.

To convert feet to meters, multiply feet by 0.3048.

Base from U.S. Geological Survey, 1961

Compiled in 1979

SCALE 1:24000

1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 5 0 1 KILOMETER

TRUE NORTH
MAGNETIC NORTH
DECLINATION, 1961

NEW MEXICO
QUADRANGLE LOCATION

COAL RESOURCE OCCURRENCE MAP OF THE MESA PORTALES QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

BY
DAMES & MOORE
1979

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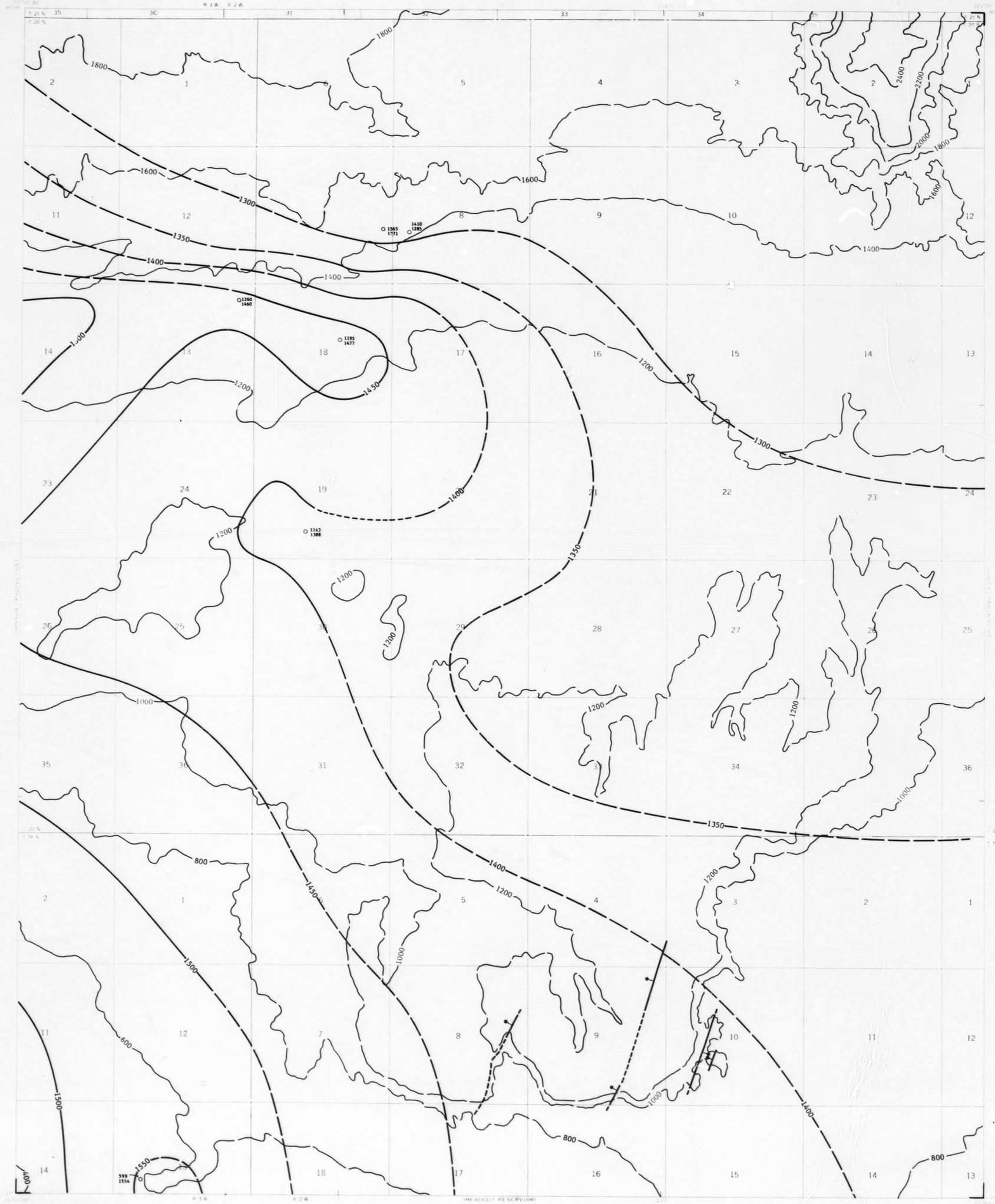
PLATE 5
STRUCTURE CONTOUR MAP OF THE MENEFEE COAL ZONE

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MESA PORTALES QUADRANGLE
NEW MEXICO-SANDOVAL CO
7.5 MINUTE SERIES (TOPOGRAPHIC)

OPEN FILE REPORT 79-809
PLATE 6 OF 6



EXPLANATION

1200

OVERBURDEN ISOPACHS - Showing thickness of overburden, in feet, from the surface to the top of the Menefee coal zone, which is coincident with the top of the La Ventana Tongue. Isopach interval 200 feet (61 meters). Isopachs dashed where inferred.

1400

INTERBURDEN ISOPACHS - Showing thickness of interburden, in feet, within the Menefee coal zone. Isopach interval 50 feet (15.2 meters). Isopachs long dashed where inferred and short dashed where projected through noncoal-bearing area.

○ 1195
1477

DRILL HOLE - Showing thickness of overburden, in feet, (upper number) from the surface to the top of the Menefee coal zone, which is coincident with the top of the La Ventana Tongue, and thickness of interburden, in feet, (lower number) within the Menefee coal zone.

FAULT - Dashed where approximately located; bar and ball on downthrown side.

To convert feet to meters, multiply feet by 0.3048.

The Menefee coal zone extends from the top of the La Ventana Tongue (Cliff House Ss) to the base of the Menefee Fm. The La Ventana Tongue and the Hogback Mtn Tongue (Menefee Fm) interfinger and are contemporaneous. The Menefee zone overburden is determined by subtracting the elevation of the top of the La Ventana Tongue (CRO Plate 5) from the ground level elevation. The interburden is the noncoal-bearing portion of the Menefee coal zone (i.e., the combined rock thickness of the undifferentiated Menefee Fm and the La Ventana Tongue).

Base from U.S. Geological Survey, 1961

SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 KILOMETER

Compiled in 1979

TRUE NORTH
MAGNETIC NORTH
DECLINATION 1961

NEW MEXICO
LOCATION

COAL RESOURCE OCCURRENCE MAP OF THE MESA PORTALES QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

BY
DAMES & MOORE
1979

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PLATE 6
ISOPACH MAP OF OVERBURDEN AND INTERBURDEN OF THE MENEFEE COAL ZONE